UNIT 4 - ENVIRONMENT
SECTION 2 - SMOGASBORD

Vocabulary

Clean Air Act of 1970	**near-nonattainment area**	**pollution**
Clean Air Act Amendments of 1990	**nonattainment area**	**smog**
	particulates	**smorgasbord**
criteria pollutants	**parts per million**	**volatile**
mobile-source emissions	**photochemical reaction**	

Smog is a haze of pollutants that can cause problems with breathing, especially for people suffering from respiratory diseases. These airborne chemicals constitute a smorgasbord of hydrocarbons, carbon monoxide, and toxins.

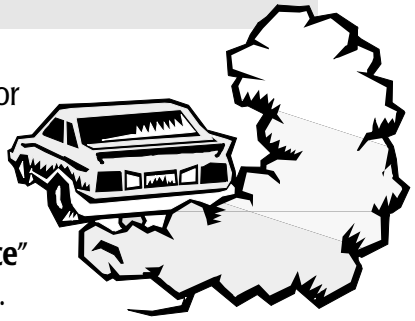


Figure 4-2-1 *After 1992 some gas stations were required to have vapor recovery systems.*

In big cities, it is common for half the air **pollution** to be caused by "**mobile-source**" **emissions**, i.e., emissions from vehicles. Fuels burn incompletely in motor vehicles. Combustion by-products emitted include soot, carbon monoxide (CO), nitrogen oxides (NO_X), and volatile organic compounds (VOCs). VOCs also can be released during the refueling of vehicles. The **Clean Air Act Amendments of 1990** require many gas stations in smoggy areas to install special nozzles on their gas pumps. The new nozzles keep harmful gases from escaping into the air and cycle them back into the gas pump. This process is called vapor recovery (Figure 2-2-8).

Besides mobile sources, air pollution is attributable mainly to industry, home and commercial energy use, use of yard equipment such as lawnmowers, and **volatile** substances such as charcoal lighter fluid, varnish, and paint.

The History of Smog

The first known published use of the word "smog" was in 1905, long before the advent of mass motor vehicle pollution. It was used in a paper called "Fog and Smoke" given by Dr. H.A. des Voeux, treasurer of the Coal Smoke Abatement Society, at a meeting of the Public Health Congress of Great Britain. He said that "smoky fog, or what was known as smog" was found only in large cities such as London. The term came to be applied to any hazy air pollution that could cause immediate, serious health problems.

Later, the word came into popular use in the United States to describe the thick haze of pollution over big cities. In the 1940s, New York, Chicago, Pittsburgh, and Los Angeles became notorious for deadly levels of smog.

Smog can contain many pollutants: smoke, dust, sulfur dioxide, acids, lead, hydrocarbons, and other emissions from industry, homes, and vehicles. But research in the 1950s made it clear that these substances, in the concentrations measured on smoggy days, could not cause the health effects observed.

In 1955, it was first suggested—correctly—that **photochemical reactions** of hydrocarbons were responsible for the health effects of smog. Photochemical reactions occur when sunlight strikes the reactive compounds (hydrocarbons and oxides of nitrogen) in the air. We know now that L.A. residents suffer particularly from smog because the city's climate and topography enhance the photochemical reactions.

4-2 SMOG ASBORD

The 1990 amendments to the federal **Clean Air Act of 1970** set guidelines for U.S. air quality. Air is monitored in cities across the nation for "**criteria pollutants**": lead, ozone (O_3), carbon monoxide (CO), sulfur dioxide (SO_2), nitrogen oxides (NO_X), and **particulates**, as well as for toxic hydrocarbons.

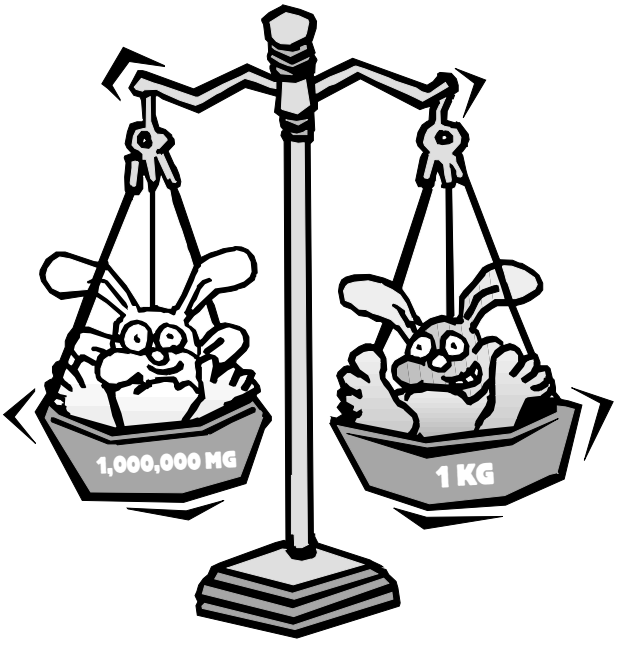


Figure 4-2-2 *There are 1,000 milligrams in one gram, and 1,000 grams in a kilogram. Therefore, there are 1,000,000 milligrams in a kilogram—about the weight of a dwarf rabbit. So, mg/kg is a measurement of parts per million. 1,000,000 milligrams is equal to about 2.2 lbs.*

These polluting compounds are measured by finding out how much of the compound is in the air compared to the amount of air being measured. This figure is expressed in **parts per million** (ppm). For example, in a volume of air containing 1 million molecules, a certain number are carbon monoxide molecules. If 50 molecules of CO are detected in a volume of air containing 1 million molecules, the CO reading would be 50 parts per million by volume.

This concept can be applied using any kind of measurement, from counting molecules to measuring volumes to weighing contaminants. For example, particulates, which consist of many molecules clumped together, are measured by weight. So, if 0.25 mg of particulates is found in a kilogram of air, the particulate reading would be 0.25 ppm by weight.

Why are such measurements important? The most widespread pollution problems are with ozone, so let's use it as an example. The Environmental Protection Agency measures each metropolitan area's ozone levels over time. If the levels are too high, the city is ranked in one of six "ozone **nonattainment**" categories specified in the Clean Air Act.

States with cities in nonattainment must submit plans showing how they will try to solve their air-quality problems. These plans often include encouraging or mandating alternative transportation fuels. Areas that come close to nonattainment (**near-nonattainment** areas) are also planning to reduce ozone to ensure they never move into the nonattainment category. Four areas in Texas are considered near-nonattainment areas: Austin, San Antonio, Corpus Christi, and the Tyler-Longview-Marshall region.

Citizens and businesses in nonattainment areas and near-nonattainment areas are concerned about their "ppm" numbers. Those air-pollution readings determine whether a city stays in its nonattainment category, achieves attainment, or moves into a more severe category. According to the law, the federal government can impose measures, such as mandating tailpipe emissions testing, requiring the use of cleaner fuels, or withholding funding for highways, if an area fails to follow the schedule outlined in its state plan.

Ozone Categories

Typical cities in the six ozone categories:

Extreme	**–**	**Los Angeles**
Severe 17	**–**	**Houston***
Severe 15	**–**	**Philadelphia**
Serious	**–**	**El Paso***
		Dallas-Fort Worth*
Moderate	**–**	**Beaumont-Port Arthur***
Marginal	**–**	**Birmingham AL**

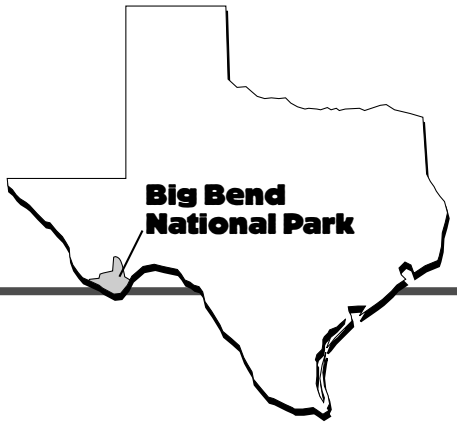
** indicates a Texas city*

Figure 4-2-3 Ozone categories

Polluted Panorama

The Big Bend National Park's scenic views of jagged peaks and craggy rocks frequently disappear. A white haze covers the picturesque vista as visibility is reduced to less than 30 miles 6 percent of the time. Before 1970, when changes in air quality began to appear, views from Big Bend spanned as much as 180 miles.

Air pollution has been a long-standing problem at the park despite the absence of industry in the immediate vicinity. Air monitoring devices show that wind patterns converge on the Big Bend region, regularly bringing air pollutants from as far away as the Midwest and as close as the Mexican state of Coahuila. Studies have identified sulfur dioxide as the primary component of the Big Bend haze.



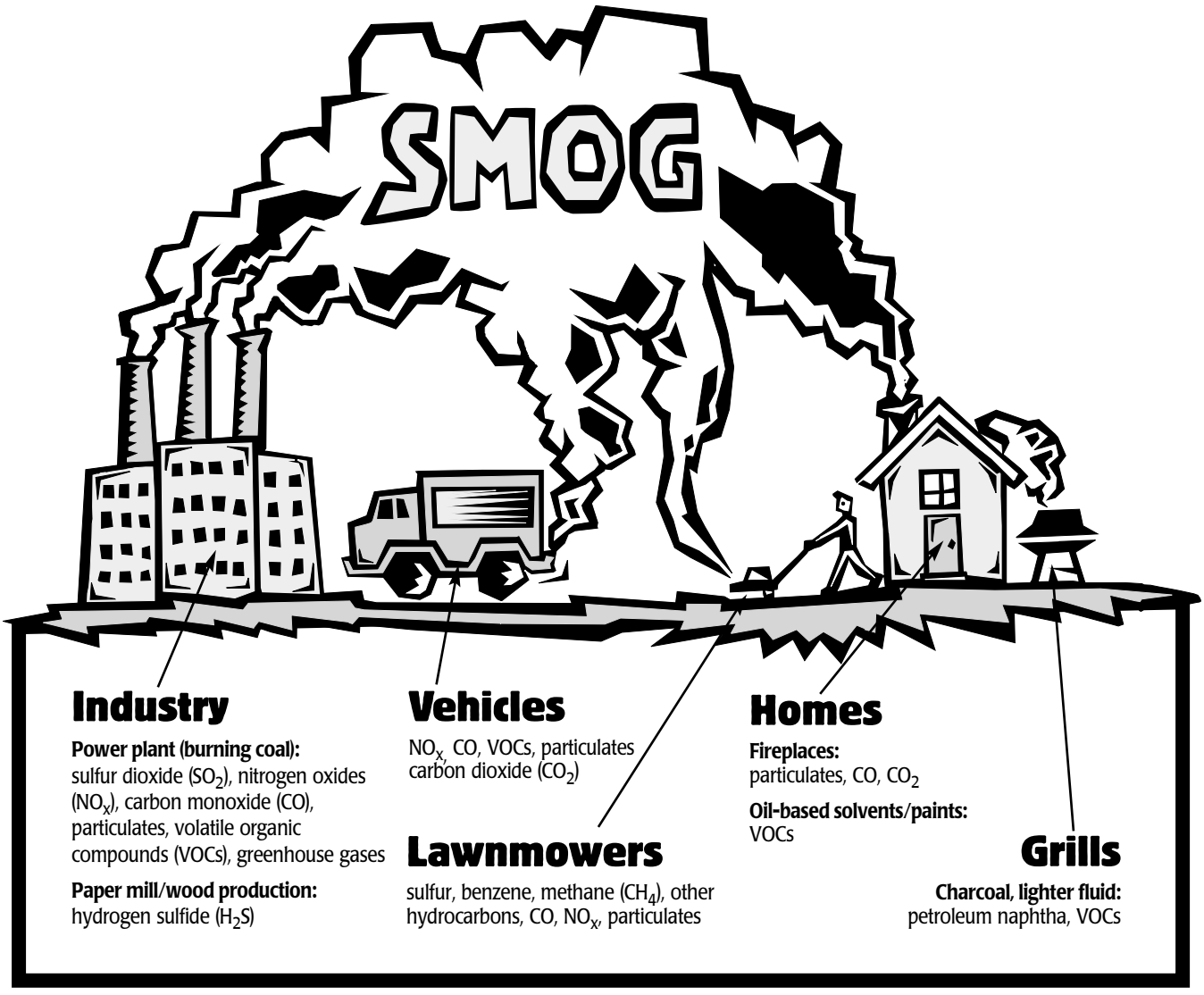


Figure 4-2-4 Air pollutants, by source

These ingredients do not necessarily result in ground-level ozone.

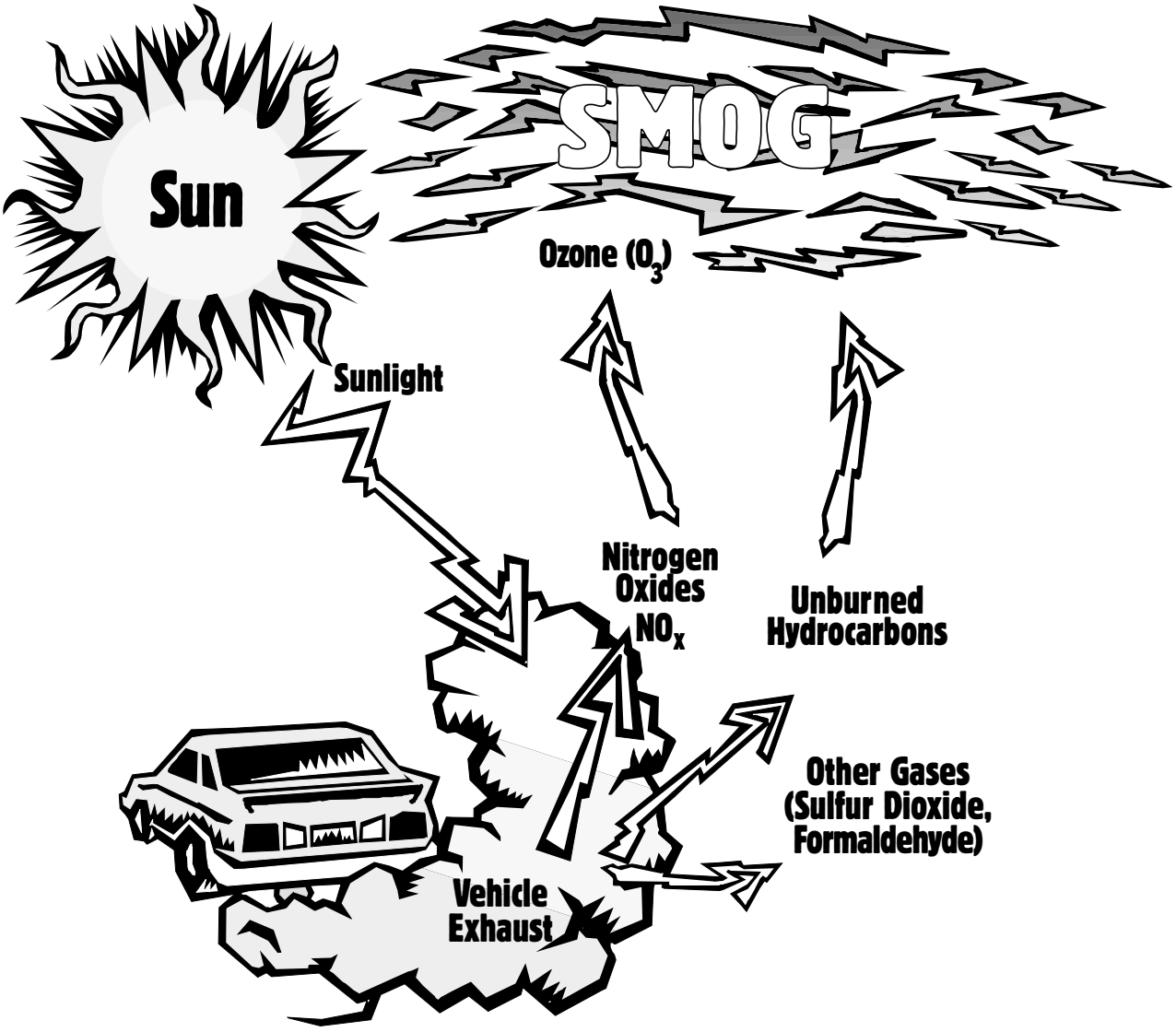


Figure 4-2-5 Ingredients of smog from vehicle exhaust

Sampling of Designated Nonattainment Areas

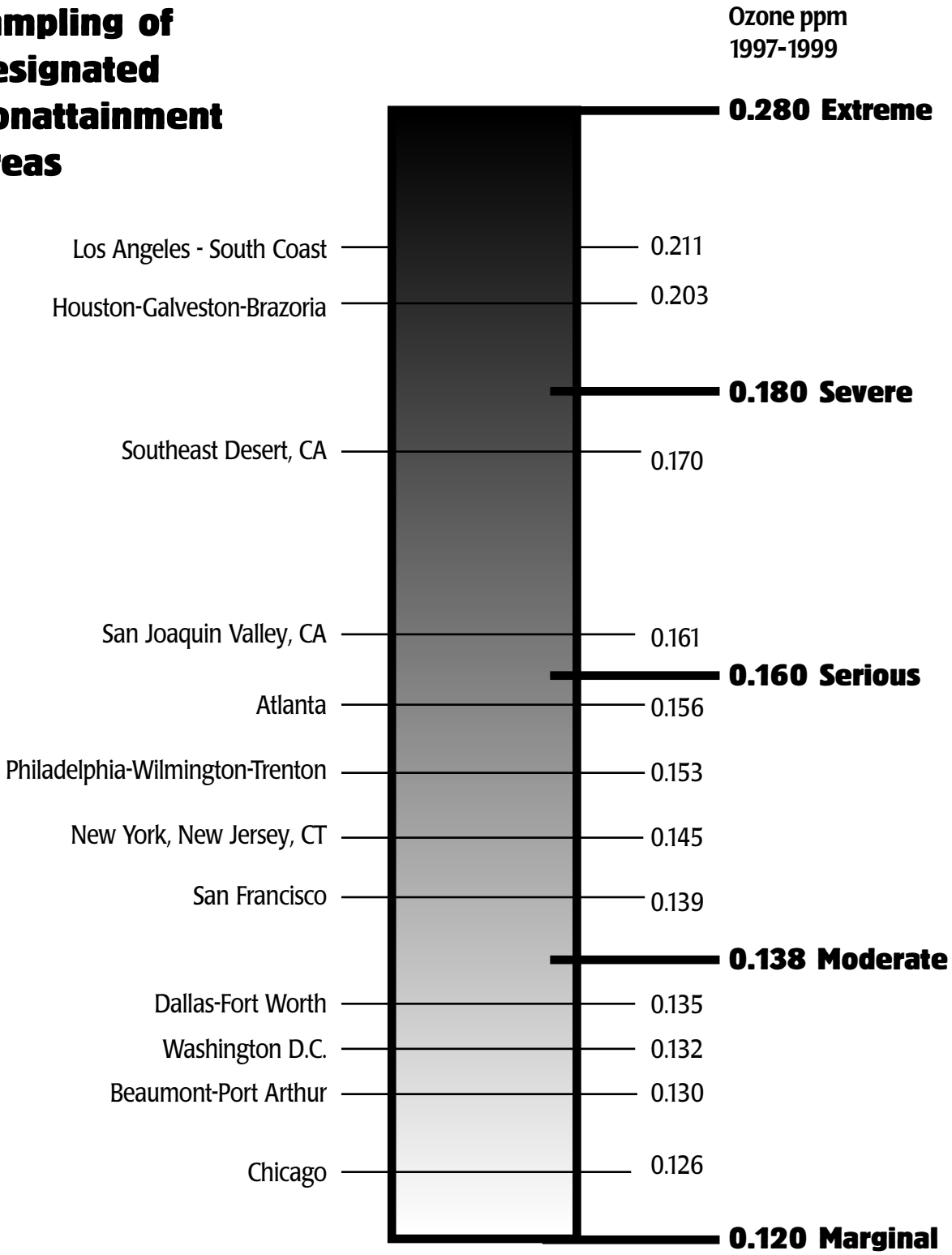


Figure 4-2-6 U.S. nonattainment areas
Source: *U.S. EPA*

Smogasbord Resource List

www.sonomatech.com/smogcity
Sacramento Metropolitan Air Quality Management District, California
Smog City is an interactive air pollution simulator that shows how consumers' and businesses' choices, environmental factors and land use affect air pollution.

www.cleanair.net/SmogSoot/smogsoot.htm
Clean Air Network, Washington, D.C.
Information on ground-level ozone and particulate matter; health and environmental effects. Links include sites that track and forecast ozone.